OXFORD CAMBRIDGE AND RSA EXAMINATIONS
ADVANCED SUBSIDIARY GCE
F212
BIOLOGY
Molecules, Biodiversity, Food and Health

TUESDAY 12 JANUARY 2010: Morning
DURATION: 1 hour 45 minutes
SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the Question Paper

OCR SUPPLIED MATERIALS:
Insert (inserted)

OTHER MATERIALS REQUIRED:
Electronic calculator
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF
INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **ALL** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **100**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

Where you see this icon you will be awarded marks for the quality of written communication in your answer.
Answer ALL the questions.

1 (a) A balanced diet is essential for good health.

Complete the following passage by using the most appropriate terms from the list to fill the gaps.

Each term SHOULD NOT be used more than once.

HAEMOGLOBIN      IRON      COLLAGEN      OBESE
CALCIUM      ANOREXIC      SODIUM

A balanced diet is one which provides an adequate intake of energy and nutrients for the maintenance of our body. If energy intake exceeds energy usage over a period of time, an individual can become ________________________ .

The deficiency disease anaemia can be caused by a lack of the mineral ________________________ in the diet. As a result of this deficiency, the body is unable to produce sufficient amounts of the protein ________________________ in red blood cells. [3]
(b) The Body Mass Index (BMI) is one way of determining whether a person is underweight or overweight.

BMI can be calculated using the formula:

\[ \text{BMI} = \frac{\text{mass in kg}}{(\text{height in m})^2} \]

Calculate the BMI of a female of mass 69 kg and a height of 1.67 m.

Show your working. Give your answer to **ONE DECIMAL PLACE**.

Answer = ____________________ [2]
Another way of determining whether a person is underweight or overweight is to use a graph showing the relationship between height and body mass.

Fig. 1.1 is an example of this type of graph.
(i) Using Fig. 1.1, state the category into which a female who has a body mass of 69 kg and a height of 1.67 m is placed.

_____________________________________ [1]

(ii) There are many factors that determine the category into which a person is placed. Fig. 1.1 does not take into account all of these factors.

Suggest why the female in (c)(i) might be placed in the wrong category.

_____________________________________

_____________________________________

_____________________________________

_____________________________________

_____________________________________

_____________________________________

_____________________________________

[2]

(d) Name TWO diseases associated with obesity.

1  _________________________________________

2  _______________________________________ [2]

[Total: 10]
Fig. 2.1 represents a water molecule.

![Water Molecule Diagram]

(a) Water molecules are polar. As a result, they attract each other.

**DRAW A SECOND WATER MOLECULE ON FIG. 2.1.**

Your drawing should show:

- the bond(s) between the two molecules
- the name of the bond
- the charges on each atom. [3]
(b) Ponds provide a very stable environment for aquatic organisms.

Three properties of water that contribute to this stability are as follows:

- The density of water decreases as the temperature falls below 4 °C so ice floats on the top of the pond.
- It acts as a solvent for ions such as nitrates (NO$_3^-$).
- A large quantity of energy is required to raise the temperature of water by 1 °C.

Explain how these three properties help organisms survive in the pond.

In your answer you should make clear the links between the behaviour of the water molecules and the survival of the organisms.
(c) Water is important in many biological reactions.

Complete Table 2.1 by writing an appropriate term next to each description.

<table>
<thead>
<tr>
<th>description</th>
<th>term</th>
</tr>
</thead>
<tbody>
<tr>
<td>the type of reaction that occurs when water is added to break a bond in a molecule</td>
<td></td>
</tr>
<tr>
<td>the phosphate group of a phospholipid that readily attracts water molecules</td>
<td></td>
</tr>
</tbody>
</table>

[2]

[Total: 13]
3 (a) The enzyme DHPS is involved in the production of folic acid in bacteria.

- The substrate for DHPS is a molecule known as PABA.

- The enzyme DHPS is inhibited by the drug sulfonamide.

Fig. 3.1 shows the structure of PABA and that of sulfonamide.

![Fig. 3.1]
(i) Diagrams X, Y and Z represent these enzyme molecules and their active sites.

State the letter, X, Y or Z, that most accurately represents the enzyme DHPS.

_____________________________________ [1]

(ii) Using the information in Fig. 3.1, explain why sulfonamide acts as a competitive inhibitor of DHPS.

_______________________________________

_______________________________________

_______________________________________

_______________________________________

_______________________________________

_______________________________________

_______________________________________ [3]
(b) Fig. 3.2 shows the effect of increasing the concentration of the substrate (PABA) on the rate of reaction.

- Curve A shows the rate of reaction without the presence of the competitive inhibitor sulfonamide.
- Curve B shows the rate of reaction in the presence of the competitive inhibitor sulfonamide.

Key:

A = without inhibitor
B = with inhibitor

Fig. 3.2
Explain the effect of increasing the concentration of substrate on the rate of reaction;

(i) without inhibitor,

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________ [3]

(ii) with inhibitor.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________ [2]
(c) Antibiotic resistance in bacteria is becoming an increasing problem.

Describe how a sulfonamide-resistant population of bacteria could develop.

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____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________


(d) Hospitals can check to see if a strain of bacteria causing an infection is resistant to a range of antibiotics by using a MULTODISC. A multodisc contains different antibiotics.

- The bacteria are isolated from a patient.
- The bacteria are spread on nutrient agar in a Petri dish.
- The multodisc is placed on the agar.

Fig. 3.3 shows a Petri dish with the bacteria, in which is placed a multodisc containing six different antibiotics.

![Fig. 3.3](image-url)
(i) Explain why there are clear areas of agar in the Petri dish.

_______________________________________

_______________________________________

_______________________________________[1]

(ii) Using Fig. 3.3, name the antibiotic that is most effective against the bacteria causing the infection.

_______________________________________[1]

(iii) Suggest THREE reasons why a hospital might use a multodisc to select the most suitable antibiotic for treating a patient.

_______________________________________

_______________________________________

_______________________________________

_______________________________________

_______________________________________

_______________________________________[3]
Drugs, such as antibiotics, are often first discovered in the natural environment. Explain why it may become increasingly difficult to discover new drugs in the future.
(a) Amino acids are the basic building blocks for proteins. Fig. 4.1 shows the amino acid cysteine.

Fig. 4.1

(i) Complete the table by selecting the letter, J, K, L or M, that represents the following groups in cysteine.

<table>
<thead>
<tr>
<th>group</th>
<th>letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>carboxyl</td>
<td></td>
</tr>
<tr>
<td>R group</td>
<td></td>
</tr>
<tr>
<td>amine group</td>
<td></td>
</tr>
</tbody>
</table>

[3]
(ii) The primary structure of a protein consists of a chain of amino acids.

Describe how a second amino acid would bond to cysteine in forming the primary structure of a protein.

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________ [3]
(b) Each amino acid has a different R group.

Describe how these R groups can interact to determine the **TERTIARY** structure of a protein.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________[4]
(c) Fig. 4.2 shows the structure of two polymers, glycogen and collagen, that are found in mammals.
(i) Complete the table below to give three \textbf{DIFFERENCES} between the \textbf{STRUCTURE} of glycogen and collagen.

<table>
<thead>
<tr>
<th>glycogen</th>
<th>collagen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(ii) Collagen is found in the ligaments which hold bones together at joints.

State \textbf{TWO} properties of collagen that make it suitable for this purpose.

1. __________________________________________

2. __________________________________________ [2]

[Total: 15]
5 (a) Coronary heart disease (CHD) can be described as a multifactorial disease. This means that a number of different risk factors contribute to the development of the disease.

Fig. 5.1 shows the percentage of cases of CHD in a population to which each risk factor contributed.

CHD due to lack of exercise (37%)

CHD due to high blood pressure (13%)

CHD due to high blood cholesterol (46%)

CHD due to smoking (19%)

Fig. 5.1

(i) When you add up the different risk factor percentages for the population you find that it is greater than 100%.

Suggest why.

________________________________________________________________________

________________________________________________________________________ [1]
(ii) State **TWO** further risk factors that are **NOT** shown in Fig. 5.1.

1 ______________________________________________________________________

2 ______________________________________________________________________ [2]

(iii) Smoking is a contributing factor in 19% of all cases of CHD. Table 5.1 lists a number of effects of cigarette smoke. Use a tick (✓) to indicate which component of cigarette smoke causes each effect. The first row has been done for you.

Table 5.1

<table>
<thead>
<tr>
<th>effect</th>
<th>nicotine</th>
<th>carbon monoxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>increases heart rate</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>constricts arterioles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>damages the lining of arteries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reduces the ability of haemoglobin to carry oxygen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>makes platelets sticky</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[4]
(b) Cholesterol is transported in the form of lipoproteins. High levels of low density lipoproteins (LDLs) in the blood are a risk factor in heart disease.

Outline the role of LDLs in the formation of an atheroma.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

[2]
(c) An atheroma can grow to a point where it restricts blood flow in a coronary artery, causing coronary heart disease (CHD).

Fig 5.2 shows a method of reducing the symptoms of CHD.

A stent is a tubular device, containing a ‘balloon’, which can be inserted into the damaged artery. The stent can be opened up by inflating the balloon.

Fig. 5.2
Explain how the inserted stent would reduce the symptoms of CHD.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

_________________________________________ [4]

[Total: 13]
DNA and RNA are nucleic acids.

(a) (i) State the components of a DNA nucleotide.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________ [3]

(ii) Describe how the structure of RNA differs from that of DNA.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________ [2]
(b) Before a cell divides, the DNA needs to be accurately replicated.

Describe how a DNA molecule is replicated.

In your answer you should make clear how the steps in the process are sequenced.
(c) (i) State what a gene codes for.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________ [1]

(ii) Suggest how changing the sequence of DNA nucleotides could affect the final product the DNA codes for.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________ [2]

[Total: 15]
Fig. 7.1, ON THE INSERT, shows a diagram of part of a heathland habitat. A study was carried out on the biodiversity of this habitat.

(a) Define the terms:

habitat ______________________________________
______________________________________
______________________________________

biodiversity __________________________________
______________________________________
______________________________________ [3]

(b) In this study, a student placed his quadrat on areas he considered to have the most biodiversity.

Explain what is wrong with this technique.

______________________________________
______________________________________
______________________________________
______________________________________ [2]
(c) The student looked at the abundance of three plants at different distances from the bottom of the slope.

The results table drawn by the student is shown below.

Table 7.1

<table>
<thead>
<tr>
<th>distance from bottom of slope</th>
<th>percentage cover of each plant species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cotton grass</td>
</tr>
<tr>
<td>0 m</td>
<td>76</td>
</tr>
<tr>
<td>10 m</td>
<td>68</td>
</tr>
<tr>
<td>20 m</td>
<td>0</td>
</tr>
<tr>
<td>30 m</td>
<td>0</td>
</tr>
<tr>
<td>40 m</td>
<td>0</td>
</tr>
<tr>
<td>50 m</td>
<td>0</td>
</tr>
<tr>
<td>60 m</td>
<td>0</td>
</tr>
<tr>
<td>70 m</td>
<td>0</td>
</tr>
<tr>
<td>80 m</td>
<td>0</td>
</tr>
<tr>
<td>90 m</td>
<td>0</td>
</tr>
<tr>
<td>100 m</td>
<td>0</td>
</tr>
</tbody>
</table>

(i) The format of the student’s table is incorrect. Suggest ONE way in which the student could correct the table.
Fig. 7.2 is a graph showing the distribution of cotton grass and bracken at different distances from the bottom of the slope.

(ii) Using the information in Table 7.1, SKETCH ON FIG. 7.2 a curve to show the distribution of LING. [3]

(iii) Describe the distribution of BRACKEN.

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

[2]
(d) (i) The student was asked to calculate the biodiversity using Simpson’s Index of Diversity.

Suggest what additional data he would need to COLLECT in order to calculate Simpson’s Index of Diversity in this habitat.

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________ [2]

(ii) The student calculated Simpson’s Index as 0.2. This is a low value.

State the SIGNIFICANCE of this low value for this habitat.

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________ [1]

[Total: 14]

END OF QUESTION PAPER
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